CASE STUDY #3

RECOVERING LOST GOLD WITH IMPROVED EFFICIENCY, PRODUCTIVITY, AND ENVIRONMENTAL IMPACTS IN KENYA

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Artisanal gold mining in Migori, Kenya

Artisanal and small-scale gold mining (ASGM) is a subsistence level livelihood for many rural communities across the world. In Kenya, it provides work for an estimated 40,000 people and produces 5 metric tons of gold per year (Barreto et al. 2018). The impact of ASGM is double-edged with the economic benefits offset by damage to the environment and the health of mining communities, particularly due to the widespread use of mercury to recover gold. As a signatory to the Minamata Convention on Mercury (UNEP 2017), Kenya has agreed to eliminate the use of mercury, formalize the ASGM sector, introduce good practice, and protect the health of mining communities.

Migori County is a major ASGM center in southwest Kenya where gold is produced from quartz–carbonate reefs in metamorphosed mudstones and volcanic rocks of the Precambrian Migori greenstone belt (Government of Kenya MoM 2016). Deep unstable mine shafts propped up with wood, the use of explosives in cramped tunnels, poor ventilation, and inadequate mine dewatering make the gold mines a grim and dangerous place to work. Ore is hauled out manually, crushed using hammers, and milled in Tanzanian-designed ball mills. These mills are deafeningly noisy and are the hallmark of ASGM in Kenya. The milled ore is processed using poorly built sluice boxes and the concentrates panned with mercury. Typically, the processing is done by women to sort the good ore from bad when it comes out of the mine and sluicing and panning to concentrate the gold from the ore. The gold-mercury amalgam is heated to drive off the mercury, and a small ball of "sponge gold" is the final product. Residual gold in the tailings is recovered by cyanidation. The local ASGM communities as represented by the Migori County Artisanal Miners Co-operative (MICA) are primarily concerned about the safety of the mining, the environmental impact of mercury, and poor gold recovery.

Making production sustainable through UK-Kenya research collaboration

In response to these concerns, the British Geological Survey (BGS) initiated a two-year collaboration in August 2019 with the University of Nairobi and MICA to promote ASGM good practice, reduce mercury use, and improve gold recovery using appropriate technology. During a field visit in November 2019, samples of gold ore, crushed and milled ore, concentrates, and tailings were collected from ASGM operations. On average hard rock gold is finer than 100 microns. This makes the use of a sluice box inefficient with expected recoveries as low as 20 percent for gold of 100 microns or finer (Mitchell et al. 1997). A key characteristic of the ore is the particle size distribution of the gold—the amount of gold particles in the rock according to their size. Understanding the particle size then enables the liberation size at which the gold will be free of the ore to be determined. Initial size analysis of the milled material has shown that the gold is very fine grained. A significant proportion of the gold is smaller than ten microns in size. At this size simple gravity processing methods such as sluice boxes are very inefficient and only recover a small amount of the gold present in the milled ore.

This ongoing work will develop good practice guidance for ASGM that will be co-designed with MICA and experienced Zimbabwean Mining Engineer Terry Garde[1] that aims to align with the Kenyan Minamata Convention on Mercury National Action Plan. Direct engagement with the ASGM community will be facilitated by MICA and the University of Nairobi. This will culminate in a workshop to bring together ASGM miners; MICA and other ASGM related co-operatives (including MICRODEPRO and MICMA); Migori County and national government departments; the Migori County Geologist; and researchers from the University of Nairobi and BGS.

Workshop recommendations will inform the guidance and its dissemination. The guidance will include advice on the use of retorts to reduce mercury consumption; and the use of longer sluice channels (at least 3 meters), appropriate sluice box gradients, consistent sluice box feed supply, alternatives to manual crushing, modification to the milling, and alternative processing methods to improve gold recovery. Adopting improved ASGM practice will increase the recovery of fine-grained gold, reduce the amount of mercury consumed, and may even lead to a reduction in the use of cyanidation to recover the gold lost into the tailings. This aligns with multiple targets of SDG8 (8.2, 8.4, 8.5) to promote sustainable economic growth with appropriately upgraded technology leading to improved resource extraction efficiency, reduced environmental impact, and increased ASGM productivity

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END NOTES

1 In April 2020 Terry Garde completed a PhD on ASGM in Migori County.

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